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Aging is in the eye of the beholder: Eye-tracking and person-perception analyses of young and old faces

Stephanie M. Ha

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by

Stephanie M. Ha

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Abstract

To examine possible mechanisms related to negative attitudes of aging revealed in face processing patterns, young and old participants rated their first impressions (positive or negative) of 100 faces of young and old individuals taken from the CAL/PAL Fate Database (Minear & Park, 2004) while gaze patterns were recorded using eye-tracking methods. In a follow-up study, an independent sample of young participants rated the same 100 faces on competence, attractiveness, and subjective age in order to further assess age-related stereotypes. This study replicated the T-gaze pattern in previous eye-tracking studies (Firestone, Turk, Browne, & Ryan 2007). We also found evidence of a positivity effect exhibited by older adults on two measures of positivity. Further analyses of measures of perceptions of aging revealed that young faces were viewed more positively on dimensions of attractiveness and competence. These findings are in line with research on a negative aging stereotypes. The current study is grounded in social-cognitive theories of stereotyping and has implications for older adults as targets of discrimination and social distancing (Chasteen, 2005).

Research shows that facial cues are related to negative stereotypes. The most salient appearance cues are race, sex, age, and facial expression, in that order (Milord, 1978). Cues of aging, for example, influence people's perceptions of older adults. In one study, older adults who looked younger were rated more favorably by college students and children than older-looking older adults (Hummert, 1994). In another study, even older adults rated photographs of the oldest-looking older adults more negatively than did middle-aged and younger adults (Hummert, Garstka, & Shaner, 1997). Taken together, these studies suggest that faces are powerful sources of stereotypes, and in particular, that aging in faces may cue age-related stereotypes.

Evidence suggests that when studying faces similar to their own, individuals are more likely to remember and discriminate these faces better than faces that are different. Studies in face recognition and person identification reveal an "own-age bias," suggesting adults are more likely to identify, recognize, and remember faces when viewing faces of their own age (Anastasi & Rhodes, 2006). Sporer (2001) proposed an in-group/out-group model (IOM) of face processing that suggest that this occurs because people employ different processing strategies when viewing in-group versus out-group faces. Specifically, out-group faces are viewed more superficially by in-group members, and are placed quickly into an out-group category without further attentional processing. Research on the own-age bias using event-related potential (ERP) and eye-tracking methods supports this claim, finding that age is important in regard to the experience the subject has with the target face (Melinder, Gredebäck, Westerlund, & Nelson, 2010). The IOM model is further supported by evidence in face recognition and person identification, where participants were more likely to recognize faces that fell within their same age group (Bartlett & Fulton, 1991). The operation of in-group and out-group biases may put one group at a disadvantage if only out-group faces are used in face identification studies. For

example, presentation of younger faces only put older participants at a disadvantage when required to process and recognize young faces (Bastin & Van der Linden, 2003). Restricting target face stimuli to one age introduces a confounding variable when analyzing age group differences of perceivers on face recognition tasks. Thus, it is important to use face stimuli systematically by balancing face stimuli age with perceiver age to take into counteract the own-age bias effect. In order to address this problem, Minear and Park (2004) created the CAL/PAL Face Database, a large representative sample of photographs of faces from people of different ages. This database allows researchers to systematically vary the age of faces used as experimental stimuli when conducting age-comparative studies. Information on specific characteristics of the face stimuli (e.g., attractiveness, likeability) has been collected by Ebner (2008) but is incomplete. One purpose of the present study was to collect additional information on faces from the CAL/PAL database for researchers to use in future age-comparative studies.

When viewing faces, humans tend to focus on the eyes, nose, and mouth (Firestone et al., 2007), but this tendency varies by age of face and perceiver. Human faces of different ages differ on several aspects. Physiognomic cues for age include placement of eyes, nose, and mouth, size of the cheeks, texture of skin, and presence and color of hair (Berry & McArthur, 1986). Past research suggests that when determining the age of a face, human vision is sensitive to differences and changes in features and age-associated changes, even when subtle and difficult to describe (Bruce & Young, 1998). In addition to these surface-level features, faces may convey underlying personality characteristics or behavior and motive structures (Berry & McArthur, 1986; Berscheid & Walster, 1874). Since negative stereotypes and generalized expectations of older adults are well documented, it seems plausible that the perceived age of face may influence underlying personality characteristics that individuals assign to a face. For example, the

perceived age of a face may strongly influence on how attractive or competent a face is seen to be. In line with this assumption, Ebner (2008) found that old faces from the CAL/PAL Face Database were judged as less positive than young faces from the database on characteristics of attractiveness, likability, distinctiveness, growth-orientation, and energy. These effects may be due to stereotypes and generalized expectations regarding aging.

A recent review of age stereotypes indicates that older adults hold more complex views of aging than do younger adults (Hummert, 2011), and a meta-analysis of attitudes towards aging supports this claim (Kite, Stockdale, Whitley, & Johnson, 2005). Greater complexity and differentiation is consistent with the out-group homogeneity principle, which predicts that "… perception of variability within a stereotyped group is influenced by one's status as an in-group or out-group member" (Park & Rothbart, 1982, p. 1052). Specifically, people tend to perceive out-group members as more similar and in-group members as more diverse. Indeed, in-group differentiation, variability, and favoritism (the 'in-group favoritism effect') by older adults have been demonstrated empirically (Chasteen, 2005; Linville, Fischer, & Salovey, 1989). By extrapolation, perceptions of older adults held by older adults should be more heterogeneous, differentiated, and favorable than those held by younger adults.

One purpose of the present study is to uncover one source of age-related stereotypes held by younger adults, specifically, biased processing of facial features of older adults through the usage of eye-tracking technology. A second purpose is to provide face-specific ratings for a subset of young and old faces from the CAL/PAL Face Database in order to assess stereotypical processing of faces of different ages. In our study, participants were asked to judge 50 young and 50 old faces in terms of first impression (positive or negative), attractiveness, competence, and subjective age. These dimensions were selected as they seem relevant for judging, processing,

and remembering young and old faces, and therefore provide relevant information for future age-comparative research using face stimuli. Attractiveness and subjective age estimates may be influenced by surface-level facial features, while ratings of competence refer to underlying personality characteristics that lie "behind the face" (Berry & McArthur, 1986).

In this study, we assumed that ratings of faces will be strongly influenced by stereotypes and general expectations held by younger and older adults. The research reported here draws from several previous studies that examined stereotypes of aging and face processing, both explicit and implicit. We examined age differences in perceptions of old and young faces, and we examined how younger adults perceive the attractiveness, competence, and subjective age of younger and older adults. This research is important because older adults are often targets of discrimination and social distancing (Chasteen, 2005; Luszcz & Fitzgerald, 1986), and report feeling "invisible" to younger cohorts (Spiro, 2009; Simon, 1996).

We hypothesized that younger adults would process faces of different ages according to in-group and out-group biases (Park & Rothbert, 1982). This would result in younger adults viewing faces of their own age group holistically while viewing those of an out-group, older adults, in a more feature-based manner. If our hypothesis is correct, younger adults should focus more on characteristics of older faces that indicate aging, such as wrinkles around the mouth, eyes, and neck. In contrast, older adults should be more likely to view young and old faces more equivalently and holistically, looking at main features such as the mouth, nose, and eyes, as well as characteristics of aging to distinguish faces. According to the IOM model of face processing, older adults, unlike younger adults, should tend to individuate older faces. We also predicted that younger adults would display patterns of the in-group favoritism effect, judging old faces as less positive than young faces, and rating older faces as less attractive and competent.

Experiment 1

Method

Participants

Sixty-one younger adults (ages 18-28; 41 female, 20 male) and sixty-eight older adults (ages 60-88; 48 female, 20 male) participated in this study. The younger adults had a mean age of 19.55 years (*SD* = 1.99) and a mean education of 13.31 years (*SD* = 1.42). The older adults had a mean age of 70.85 years (*SD* = 6.99) and a mean education of 16.16 years (*SD* = 2.01). Older adults had higher vocabulary scores (*M* = 29.08, *SD* = 2.75) than did younger adults (*M* = 24.87, *SD* = 2.75), $p = 0.001$, as measured by the Ekstrom, French, Harman, and Dermen (1976) Synonyms Test (a vocabulary test). Younger adults exhibited higher processing speeds (*M* = 72.29, *SD* = 9.33) than did older adults (*M* = 54.22, *SD* = 9.66), $p = .001$, as revealed by the WAIS-R Digit-Symbol Substitution Task (DSST, Weschler, 1981). Participants were compensated with $15 at the end of the study.

Procedure and Measures

Participants were tested individually in one session. After providing informed consent, all participants completed the eye tracking measure first. Following the eye tracking measure, the order in which implicit and explicit measures were completed was counterbalanced. The Digit Symbol Substitution Test and the Synonyms task were administered at the close of the study. Before each test was administered, subjects completed a practice test designed to ensure that all test instructions were understood.

To collect data on how individuals process faces, participants' eyes were tracked as they gazed at photographs of faces. Participants placed their heads against the headrest and observed the screen. The eye tracker (EyeLink 1000) recorded location and duration of gazes. 50 younger faces (25 male) and 50 older faces (25 male) were presented for 5 seconds each. Participants were asked to indicate their first impression (positive or negative) of each face using a hand-held game controller with two buttons, one on the left and one on the right. For half of the participants, the left button was "positive" (first impression) and for the other half, the right button was "positive" (first impression). Each face was displayed until participants indicated their impressions.

Participants then completed the Age Implicit Association Test (A-IAT). This test is used to measure attitudes towards older and younger individuals that are thought to be beyond conscious awareness and control (Greenwald et al., 1998). Participants are asked to categorize young and old faces using eight positive (e.g., joy, love, pleasure) and eight negative (e.g., nasty, awful, agony) descriptors as quickly as possible. During half of the A-IAT, participants old faces were paired with negative words, and young faces were paired with positive words. During the other half of the A-IAT, old faces were paired with positive words and young faces were paired with negative words. The order for these two pairings was counterbalanced. Reaction times for each association were recorded and used to compute an overall index of attitudes towards aging, ranging from -1 to +1. More positive ratings indicate a positive preference for younger adults.

Participants also completed two questionnaires that asked them to rate a "typical" older adult and a "typical" younger adult on 22 characteristics (e.g., competent, inactive, healthy, good at crossword puzzles, bad memory) ranging from 0 (not at all) to 10 (completely). These two

measures were counterbalanced so that half of the participants rated the "typical" young adults first, and half rated the "typical" older adult first.

Finally, participants completed measures of how similar and different they felt to younger and older adults on 8 items, and completed a questionnaire of how much contact they had with each age group.

At the end of the study, participants completed the Digit Symbol Substitution Test and the Synonyms task, followed by an eye exam and reported visual impairments.

Results

Analyses of gaze patterns failed to support our hypothesis of differential looking at old faces by younger and older adults: Both younger and older adults focused more on main features in the T-area than other areas outside the T-area. The main effect of T versus NT was significant, $F(1, 135) = 859.10$, $p = .001$. The main effect of age group was also significant, $F(1, 135) = 6.03$, $p = .015$. Younger adults had higher dwell times overall than older adults. The main effects were qualified by a significant interaction effect, $F(1, 135) = 6.01$, $p = .016$. The difference between T and NT was larger for younger adults than for older adults. The results are displayed in Figure 1.

Analyses of "first impressions" of the faces yielded a significant main effect of perceiver age, $F(1, 135) = 40.07$, $p = .001$. Overall, older adults rated the faces more positively than did younger adults. This effect was qualified by a significant interaction effect, $F(1, 135) = 10.04$, $p = .002$. Older adults rated younger faces more positively than older faces, whereas younger adults rated them similarly. The main effect of target face was nonsignificant; older and younger faces had comparable mean positivity scores. The results are displayed in Figure 2.

Analyses of the characteristics scores of "typical" young adults and "typical" older adults yielded a main effect of age group, $F(1, 147) = 11.82$, $p = .001$. Older adults endorsed more positive than negative characteristics. Additionally, younger adults were rated more positively than older adults overall $F(1, 147) = 161.35$, $p = .001$. The interaction was nonsignificant. The results are displayed in Figure 3.

Analyses of A-IAT data yielded an overall preference for younger adults, as indicated by a mean value significantly greater than the neutral midpoint ($M = 0$, equivalent preference for younger and older adults), $t(147) = 16.55$, $p = .001$. Additionally, this effect did not differ between age groups, $t(148) = -.55$, $p = .582$, and both age groups' means were significantly greater than 0, both p's $< .001$. The results are displayed in Figure 4.

Experiment 2

Experiment 1 provided preliminary data regarding perceptions (gaze patterns and positivity ratings) of young and old faces by young and old perceivers. We found that both younger and older adults looked more at eyes, nose, and mouth areas of faces, than outside of these areas, supporting the so-called T-effect (Firestone et al., 2007). We also found that both older and younger adults rated younger adults more favorably than older adults across several domains of functioning, personality, and cognition, and on the A-IAT. Moreover, younger faces were perceived more positively than older faces, and that this was particularly true for older adults, supporting an age-related positivity effect (Reed & Carstensen, 2012). However, positive and negative first impressions were the only explicit measurements of perception obtained from the stimulus faces in our first experiment. The purpose of Experiment 2 was to obtain face-specific ratings of all 100 stimulus faces used in Experiment 1 in order to further assess stereotypical processing of faces by perceivers. We assessed three dimensions of faces and/or

individuals that have been observed in past research on stereotypes of aging: Competence, Attractiveness, and Subjective Age.

Method

Participants

Data were collected from 57 undergraduate students attending a small liberal arts university who received course credit for their participation. Of the 57 participants, 13 were male and 40 were female, ranging between the ages of 17 and 21 (M =18.56, SD = .848). Subjects were recruited using campus ads and class announcements. All potential subjects either called or emailed the research lab and were called back and scheduled by student researchers.

Procedure

Participants completed three separate testing sessions in the same room. No more than 16 participants were testing simultaneously. Participants were randomly assigned to one of three experimental conditions determining the order of characteristics being rated. Prior to completing the face ratings task, all participants completed a background questionnaire and consent form. The face ratings task required participants to rate the 100 faces (50 older, 50 younger; see Experiment 1) on three characteristics: age, competence, and attractiveness on a scale of 0 to 10. Faces were presented for 5 seconds each while participants rated the faces. The tasks were presented on a computer and were programmed using Qualtrics software. Participants were debriefed following the completion of the study and thanked for their participation. Participants who were members of the Introduction to Psychology course received course credit.

Results

In order to determine whether participants held different perceptions of competence, attractiveness, and subjective age of young and old faces, we ran three separate three-way analyses of variance, 2 (participant sex) x 2 (target sex) x 2 (target age).

Analysis of competence ratings revealed a main effect for sex of faces, $F(1, 56) = 9.75$, $p = .003$. Female faces were seen as significantly more competent than male faces. The main effect for age of face was also significant, $F(1, 56) = 64.02$, $p = .001$. These effects were qualified by a significant interaction between sex of participant and age of face, $F(1, 56) = 15.09$, $p = .001$. Young female and male faces were rated as equally competent, but old female faces were rated as significantly more competent than old male faces, see Figure 5.

The main effect of target sex was significant, female faces were rated as more attractive than male faces, $F(1, 55) = 14.59$, $p = .00q$. The main effect of target age was significant, young faces were rated as more attractive than old faces, $F(1, 55) = 170.02$, $p = .001$. However, these main effects were qualified by a significant three-way interaction effect $F(1, 55) = 10.40$, $p = .002$. Analyses within participant sex revealed that males rated young female faces significantly more attractive than young male faces, however rated all old faces similarly in attractiveness. This effect was not seen for female raters, who rated female faces significantly more attractive than male faces for both young and old faces, see Figures 6 and 7.

Analysis of subjective age ratings revealed a main effect for sex of faces, $F(1, 56) = 4.20$, $p = .045$. Female faces were seen as significantly younger than male faces. The main effect for age of face was also significant, $F(1, 56) = 6420.01$, $p = .001$. These effects were qualified by a significant interaction between sex of participant and age of face, $F(1, 56) = 4590.98$, $p = .001$.

Young female faces were rated as significantly older than young male faces. However, old female faces were rated as significantly younger than old male faces, see Figure 8.

Discussion

In the present study, participants were asked to view a selection of 100 faces of young and old individuals from the CAL/PAL Face Data-base (Minear & Park, 2004) and rate negative or positive first impressions while gaze patterns for each face were recorded using eye-tracking methods. In a follow-up study, an independent sample of young participants rated the same 100 faces on competence, attractiveness, and subjective age in order to generally assess age-related stereotypes. The central purpose of the study was to analyze gaze pattern data to examine possible mechanisms related to negative attitudes of aging revealed in face processing patterns. A second purpose of the present study was to provide ratings relevant for judging, processing, and remembering young and old faces for this selection of face stimuli. Analyses pertaining to this second purpose showed that younger participants rated young faces more positively in dimensions of competence and attractiveness than old faces. These results confirm previous findings suggesting negative stereotyping of old faces (Hummert, Garstka, O'Brien, Greenwald, & Mellot, 2002).

Given that gender stereotypes for younger adults are well documented, an additional factor to consider is sex of the target older adult. Foos & Clark (2011) found that when comparing differences in perception in male versus female faces, old female faces were rated lowest in attractiveness across all age and gender groups. In line with these findings, there is evidence that while women's faces were generally seen as more attractive, the decline in attractiveness over the lifespan was greater for women than for men (McLellan & McKelvie, 1993). To explain why older women are stigmatized more so than older men, Sontag (1972)

proposed the “double standard of aging”, which refers to the fact that while men are valued more for their accomplishments (which increase with age), women are valued for their appearance (which diminishes with age).

Despite this, research investigating target gender differences of old people is inconsistent, with some researchers finding no evidence of a double standard (Drevenstedt, 1981; Locke-Connor & Walsh, 1980; Narayan, 2008). A meta-analysis by Kite et al. (1995) was also unable to find evidence for a double standard, and in fact concluded that old males are perceived as more incompetent than old women. The finding from the current study that old female faces were perceived as more competent than old male faces is consistent with this research. These results are likely because competence is a principal element of the male stereotype and therefore is believed to diminish with age (Kite, 1996).

In support of this assumption, much of the past research done supporting the double standard of aging has tested differences in perceived attractiveness, a central value in women (Halliwell & Dittmar, 2003). While the finding in the current study that female raters perceived old female faces as more attractive than male faces does not support this, analysis of subjective age revealed that the mean age for old female faces was perceived as significantly younger than the mean age for old male faces. This may explain the lack of double standard seen in ratings of attractiveness, because older females were seen as 15 years younger than older males, on average.

Upon analysis of attractiveness ratings across both genders, old faces were rated as less attractive by younger participants. This finding replicates the evidence from an earlier study that young and old participants rate young faces as more attractive than old faces (Ebner, 2008). Physiognomic cues for age including placement of eyes, nose, and mouth, size of the cheeks,

texture of skin, and presence and color of hair (Berry & McArthur, 1986) may influence these lower attractiveness ratings obtained for old faces. Analyses of gaze patterns revealed higher dwell times for both younger and older participants within the "T-zone" in comparison to non-T areas of the face. While this finding replicates T-gaze patterns in eye-tracking studies (Firestone et al., 2007), our hypothesis that younger adults would look more in non-T areas of the face for signs of aging was not supported.

Interestingly, in addition to differential judgements as a function of age, findings from first impression of faces and CRS scores show that older adults rated faces overall more positive, thus providing evidence for a positivity effect in older adults. This finding is consistent with results from past eye-tracking studies which show that older adults are more likely to direct their gaze away from sad or angry faces and focus more attention on happy faces (Mather & Carstensen, 2003; Isaacowitz et al., 2006). This effect is generally explained by the socioemotional selectivity theory, which states perceived time horizons play an important role in motivational shifts which influences cognitive processing (Reed & Carstensen, 2012). Additionally, these results support findings from Ebner (2008) who also found a positivity effect in older adult ratings on multiple dimensions.

While gaze pattern analysis did not reveal underlying attentional mechanisms by which stereotypes of aging might manifest, the fact that signs of aging also occur within T-areas of the face (Berry & McArthur, 1986) may have contributed to a lack of significant findings. Defining more specific areas of aging on faces within the T and non-T areas of the face may help uncover these attentional mechanisms. Additionally, since past research provides evidence that surface-level facial features related to aging may influence judgements of attractiveness (Ebner, 2008; Berry & McArthur, 1986), future eye-tracking studies can assess whether gaze patterns focus

more on signs of aging when assessing characteristics such as attractiveness. Additional limitations include the lack of an older adult sample in assessments of attractiveness, competence, and subjective age for the 100 faces we used. While the primary interest of this study was to reveal stereotypes of aging held by younger adults, the addition of an older adult sample would allow us to assess age differences in perceptions of competence and attractiveness related to the 100 faces we selected from the CAL/PAL database, thereby providing additional normative information for these stimuli. In addition, including a middle age group in future studies may reveal at what age these biases begin to emerge.

Overall, the finding that old faces were rated more negatively than younger faces by older adults is in line with evidence that old age is generally perceived as more negative than young age, by both young and old individuals (Hummert et al., 2002), providing support of a negative aging stereotype. These findings are important because, according to social developmental views of ageism, accurate perceptions regarding aging could be shaped as early as early childhood (Levy, 2009; Montepare & Zebrowitz, 2002; North & Fiske, 2012). Additionally, the finding that young and old faces were rated differently on several dimensions provides important implications for selecting face stimuli in future age-comparative studies that aim to uncover age-related stereotypes related to the processing, perception, or memory of faces. A greater understanding of sources of negative age stereotypes could contribute to eradicating, or at least attenuating, consequences of stereotypical behavior including discrimination and social distancing (Chasteen, 2005; Fitzgerald, 1986).

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Figures

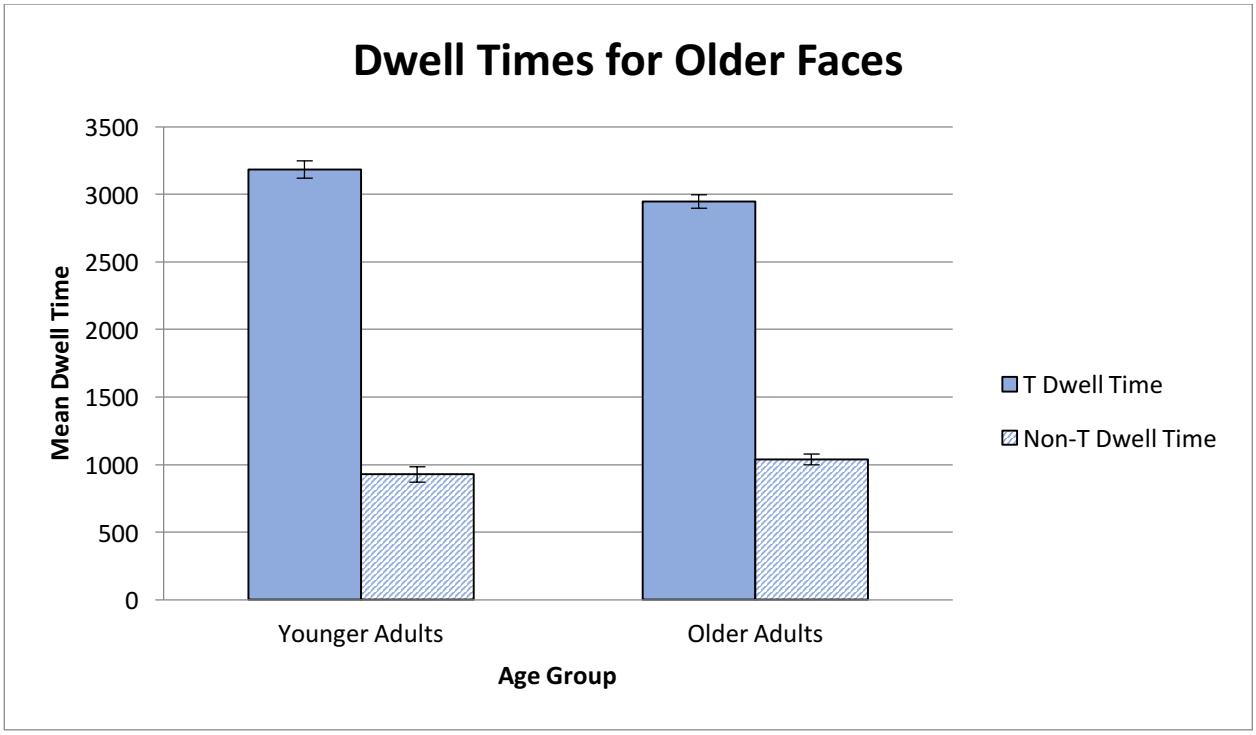

Figure 1. Mean dwell times for old faces by young adults and old adults. Dwell times in T and non-T areas of the faces were measured and recorded using eye-tracking technology.

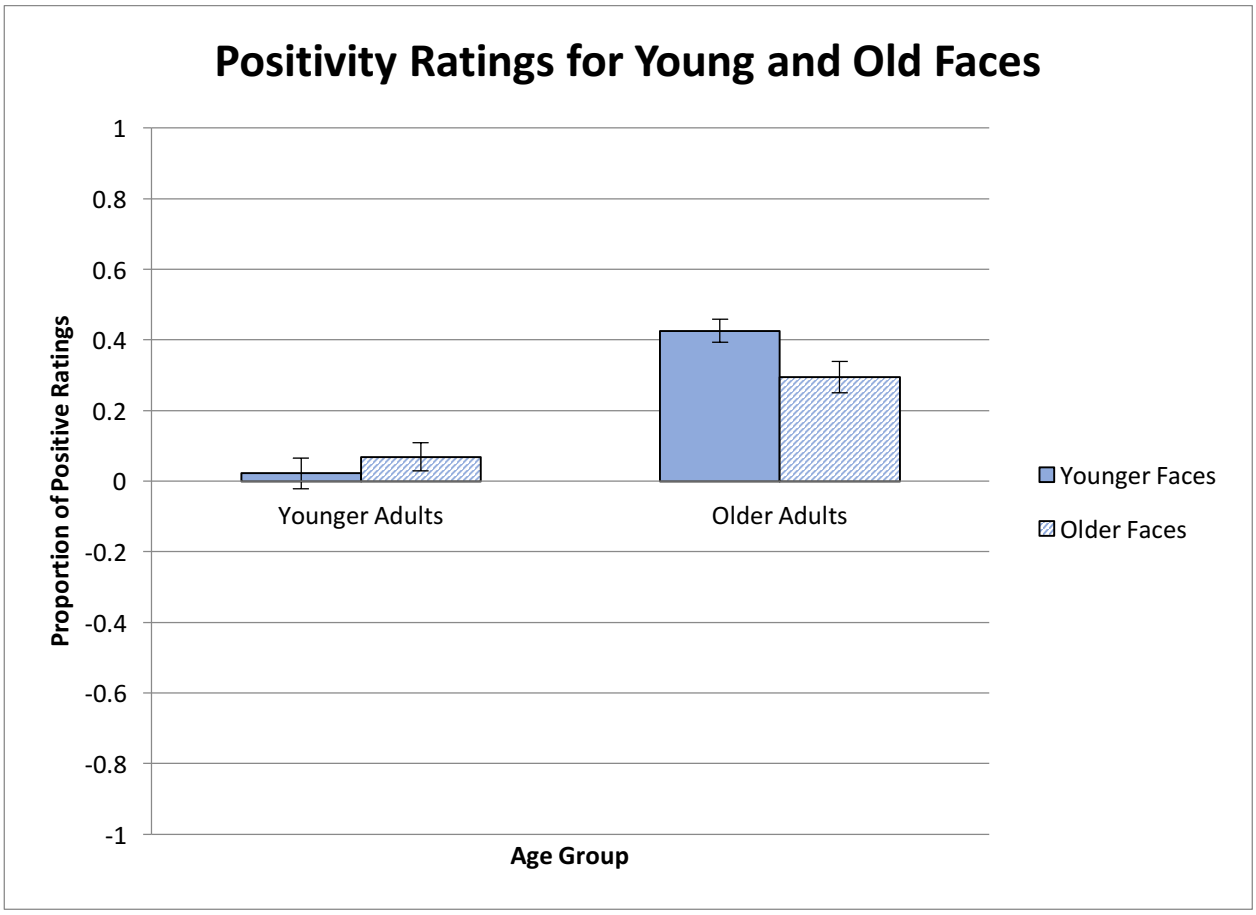

Figure 2. Proportion of positive ratings for young and old faces by young and old adults. Positive ratings represent a positive first impression of faces presented during the eye-tracking experiment.

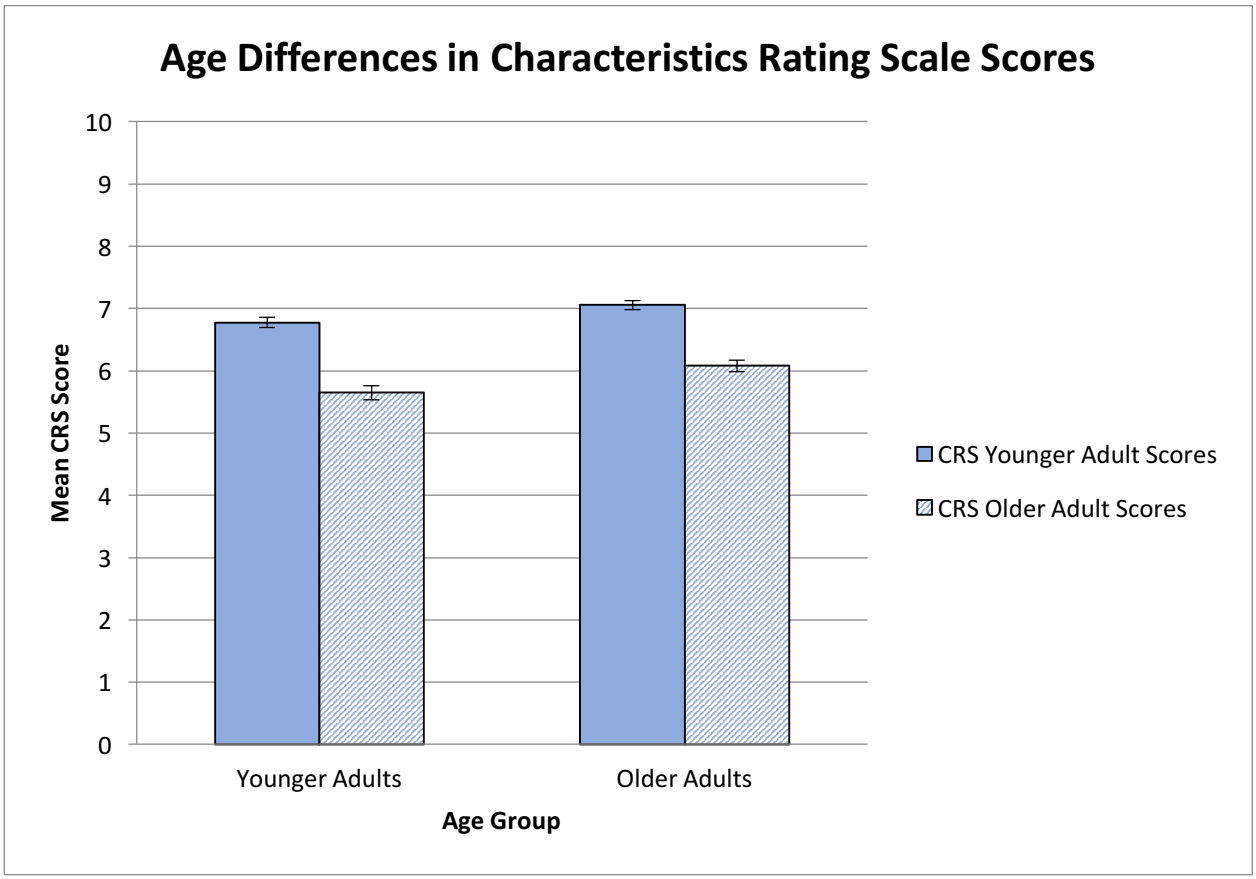

Figure 3. Mean old adult and young adult Characteristic Rating Scale scores for young and old participants measured on a scale of 0 to 10. Higher scores indicate associations with positive characteristics.

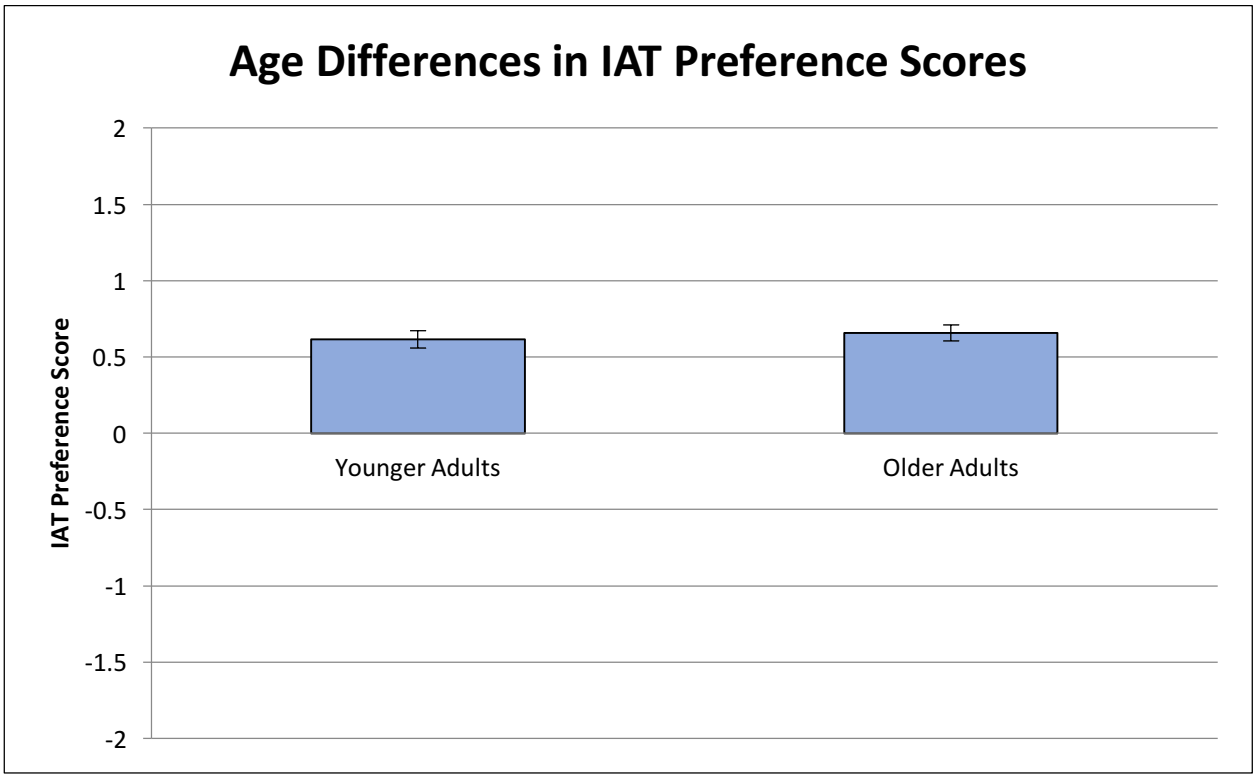

Figure 4. Mean scores of the Age Implicit Association Test. Scores ranged from -1 to +1. Positive scores indicate a positive preference for young adults, where a score of 0 indicate neutrality.

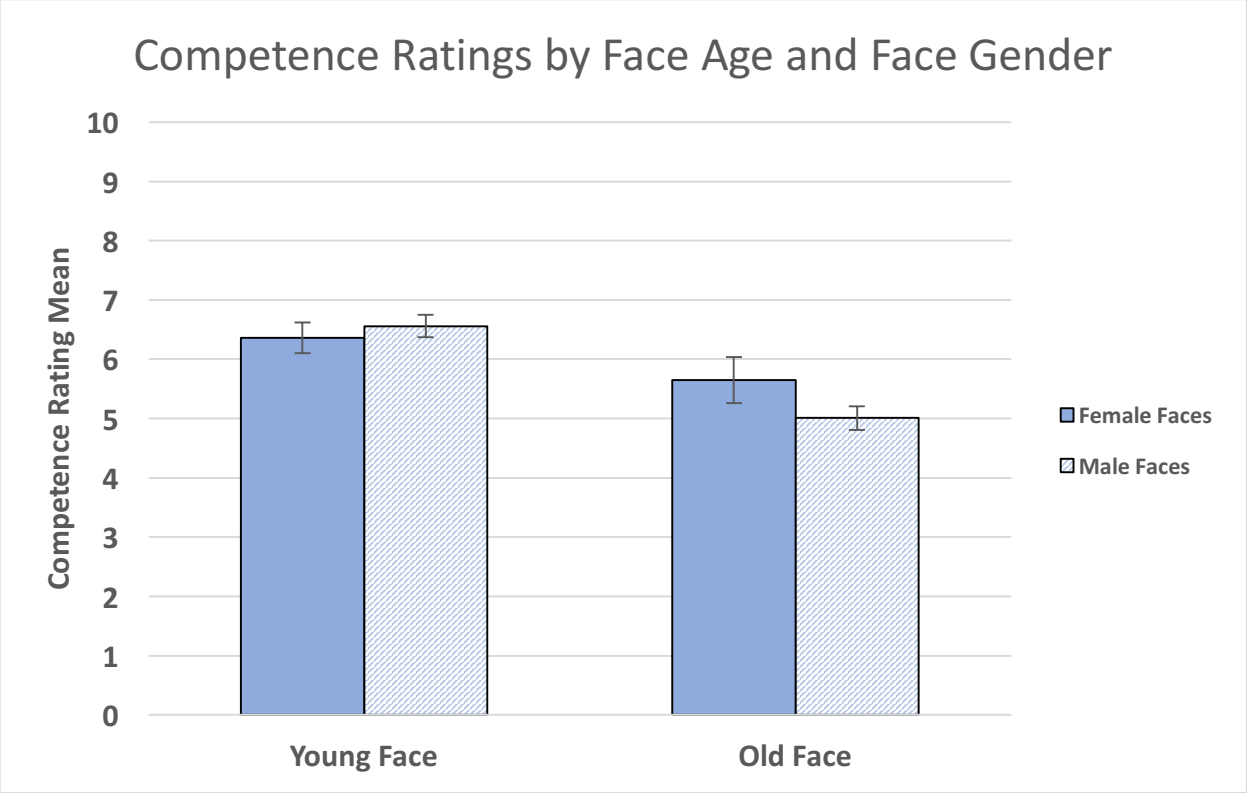

Figure 5. Mean competence ratings by face age and gender by young adult raters. Competence scores ranged from 0 to 10. Positive scores indicate higher perceived competence.

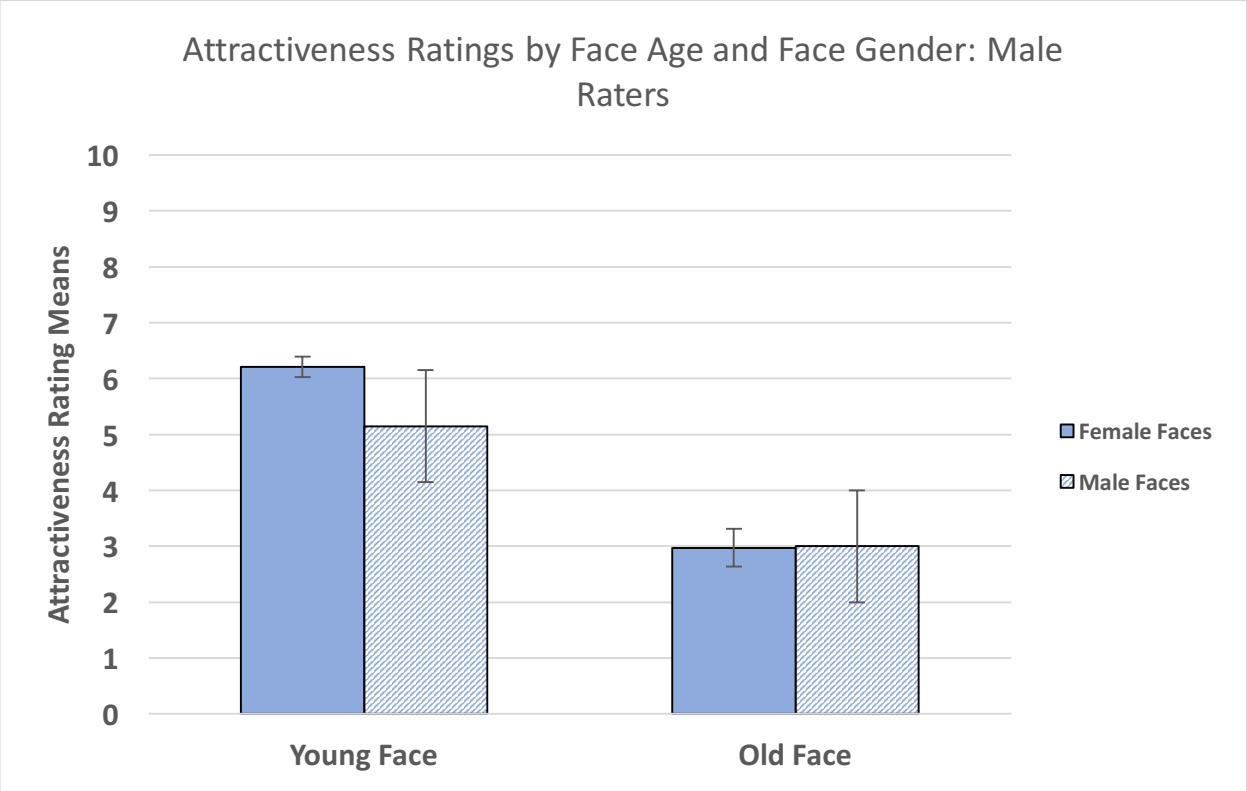

Figure 6. Mean competence ratings by face age and gender for young male raters. Attractiveness scores ranged from 0 to 10. Positive scores indicate higher perceived attractiveness.

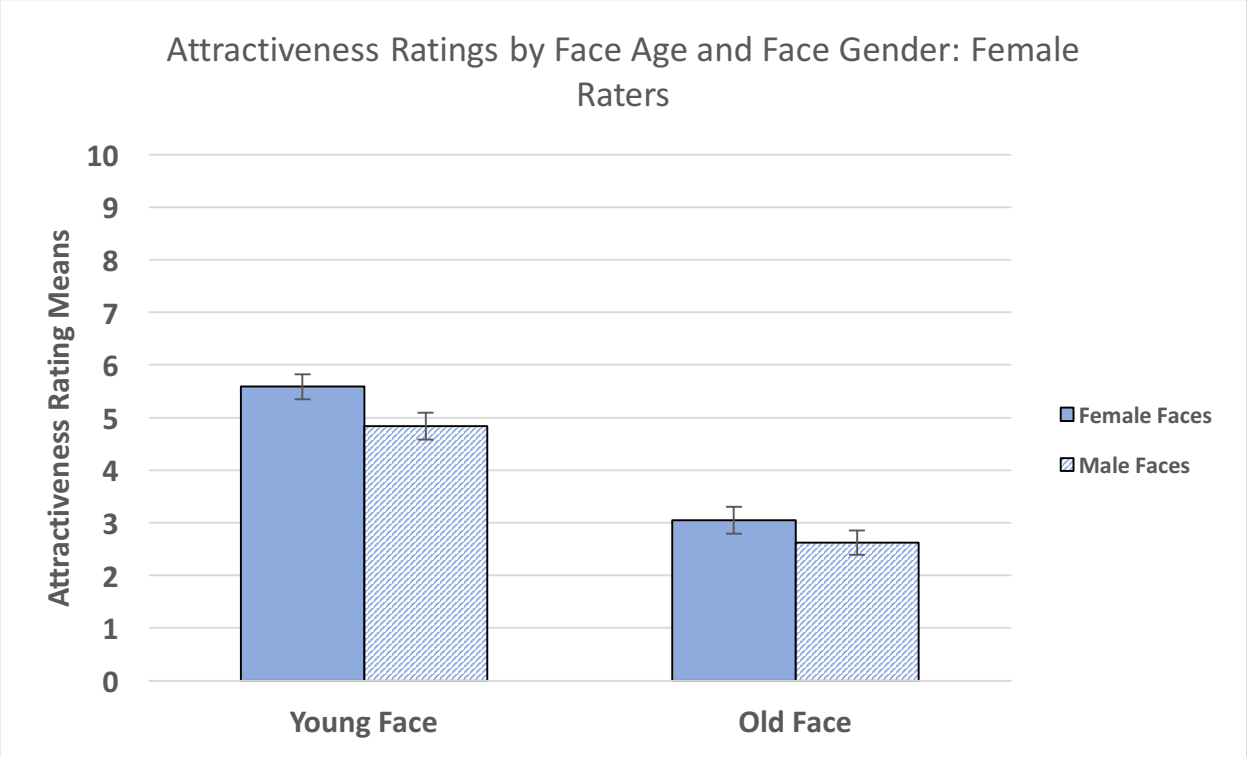

Figure 7. Mean competence ratings by face age and gender for young male raters. Attractiveness scores ranged from 0 to 10. Positive scores indicate higher perceived attractiveness.

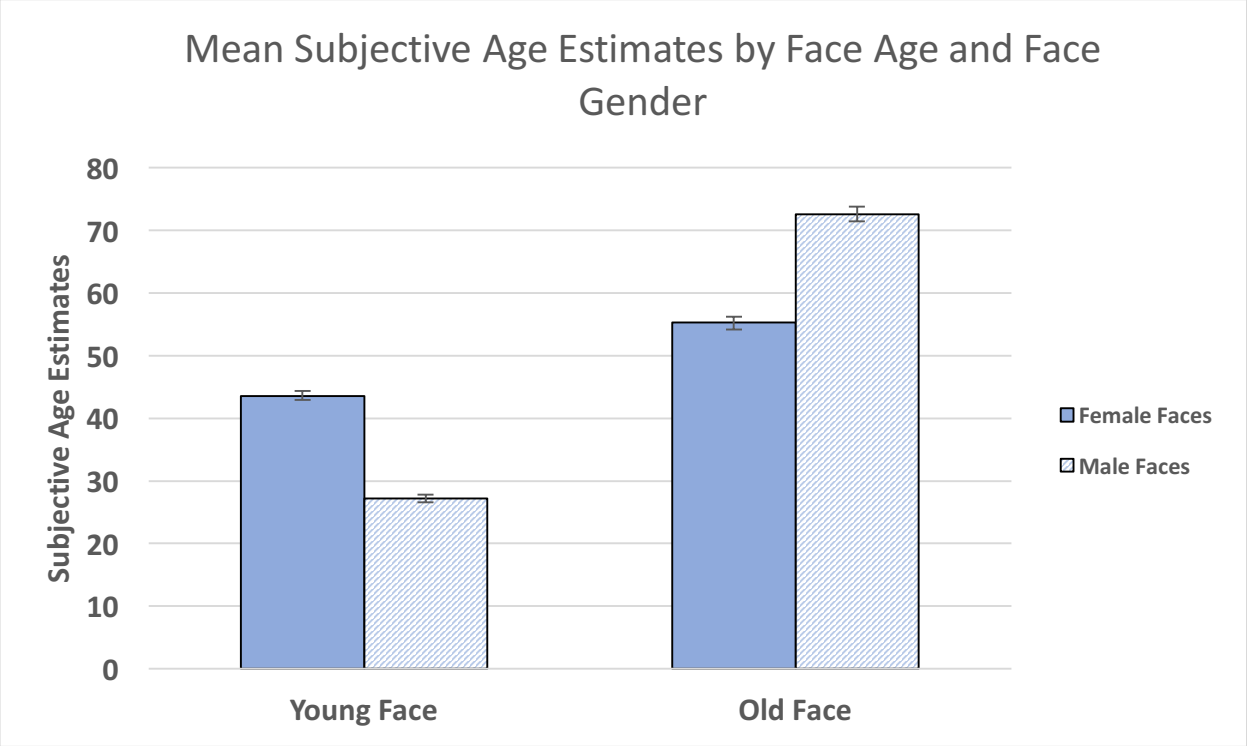

Figure 8. Mean subjective age estimates by face age and gender for young adult raters.